Polar Research in Meteorology and Climatology

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Twenty five universities returned questionnaires on meteorology. Nine were m schools having separate departments, six were returned from physics departments, r were engineering departments (aero-space and electrical, civil, electrical, l geophysics and geophysical), three came back from geology and geography artments, two from agricultural colleges and one from a marine laboratory, radar eorological section.

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The survey showed that now active in polar work are 12 professional level artment members in those schools[1] having separate meteorology departments and of similar category in those schools which do not have separate departments. given the opportunity some 48 others could participate, 22 of which are in the arate meteorology departments. Only 18 graduate students presently in schools e done, or are doing, polar research. This represents about 3 1/2% of the duate students, if in computing, the physics, engineering, geography etc. duates are lumped in; otherwise 16% of the graduate students[2] have done, or now doing, polar research.

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1. About 40% of the departments reporting have special equipment suitable polar research. Half of this number is in the separate meteorology departments; other half spread in physics, geography and engineering departments.

University of Washington - Several semi-portable masts (16m) equipped with precision anemometers, hygrometers, and thermal sensing elements for determining vertical gradients; several types of radiometers for both long and short wave radiation; numerous Speedomax, Micromax, Brown, Hartmann and Braun recorders; cold box (to-45°F); pyrheliometers; Rigsby stage; snow samplers; solarimeter; precision theodolite. The department has access to a cold room, electron microscope and some physics and oceanographic equipment.

University of Chicago - "Complete chemistry, physics labs for study of physical meteorology. These facilities, not now used in polar work per se. We are doing a lot of work on ice nucleation mechanisms - such knowledge applies to all areas of the globe. For this purpose use electron microscope, cold boxes, particulate labs, cold stage microscope, etc." (Braham)

University of Wisconsin - Cessna 195 aircraft w/floats and skis. Net radiometers (air borne and ground). Sea surface radiation thermometer (air borne).

New York University - Deep freeze

University of Utah - Calibration chamber, 3 x 5 feet; mountain meteorology laboratory (at Alta)

University of Michigan - mobile radar and cold box calibration chamber.

[1]Does not include University of Michigan; if added would make 16

[2]Includes University of Michigan; if not included figure would be 18%

Ohio State University - (Physics) Atmospheric physics group possesses considerable amount of diversified infra-red equipment.

Cornell - (Elec. Eng.) - auroral radar

Michigan State University - (Geog) large airphoto collection and photogrammetric equipment.

University of Miami - "Radar and electronic facilities for building and testing electromagnetic probing devices for use in polar regions. Complete film analysis facilities for studying radar meteorological data from polar regions" (Hiser)

2. None of the schools reporting maintain separate polar libraries. Four departmental libraries or 16% of the schools attempt to keep most classical and present polar books. About 65% more rely on their general library for the usual publications; the rest did not report or reported very limited or no polar library facilities. One school (Bowdoin) reports there is a possibility that they may obtain some of Peary's library and the books that Greely left behind.

3. Only 8% have department collections.

Washington - consists of all types of raw and reduced data on micrometeorology, ablation and accumulation, ice temperature, ice thickness, navigation, and petro fabrics of ice from Stations Alpha and Charlie.

Wisconsin - consists primarily of soil samples, floral specimens, subarctic tree ring cores, bog cores, and pollen samples together with climatic, limnological and ice data.

Several other schools report polar collections but these fall to other sub-committees such as geology, anthropology, etc.

Part III

1. Three schools offer courses dealing primarily with polar problems: Washington, Wisconsin and Michigan State (Geog).

Washington - offers a graduate seminar on polar meteorology which has been given 5 times since 1950 and demand is now sufficient to give it at least every other year. Average enrollment is about 5 students. Twice it has been given by Dr. Richard Reed and once by Dr. Franklin Badgley.

Wisconsin - Offers occasionally a seminar on polar climatology. Given by Dr. Reid Bryson.

Michigan State - (Geog). Offers every even-numbered year a course on geography of polar regions with average enrollment of 20 graduates and 20 undergraduates. Also offer a seminar in physical geography to an average of 5 graduate students each year.

2. Michigan State (Geog) is the only school contemplating offering a new course devoted to polar problems; a seminar on polar regions for graduates only.

3. Three schools (12%) report that in the past five years students theses have been completed relating to polar areas. These are: Washington, 10 Masters and 1 Ph.D., New York University, 4 Masters and St. Louis University 1 Masters.

4. Five schools (20%) report that at present students are working on theses. Washington, 2 Masters and 1 Ph.D; Wisconsin, 2 Masters and 1 Ph.D; U.C.L.A., 1 Masters; New York University, 1 Masters; Michigan State, 1 Masters and 1 Ph.D.

5. Three schools (12%) report that some of their students have had previous polar experience. Those having had IGY experience total 7 students; 3 now at Washington, 3 at New York University and 1 at Michigan State. Those having had their experience through government sponsored work total 4 or possibly 6 students; 3 are at Washington, 1 at Michigan State and perhaps 2 at Ohio State University.

Part IV

1a. Seven schools (28%) reported they had polar research projects currently in progress:

Washington - several projects including data reduction and analysis of the heat budgets of Stations Alpha and Charlie; Arctic sea-ice drift; ice petrofabrics at Stations Alpha and Charlie; heat budget of the Blue Glacier; and micrometeorology, petrofabrics and evaporation from liquid Arctic at Point Barrow.

U.C.L.A. - Reports that "some meteorological polar research is being carried on by the Institute of Geophysics - involved are one full professor, one graduate student and one research scientist".

Wisconsin - one project on heat budget of lakes.

Michigan - three projects on (1) radiative and convective heat transfer over a snow surface (2) Terrestrial scintillation over snow and (3) evaluation of heat transfer characteristics of two thermocouples probes.

New York University - one project on stratosphere meteorology

Georgia - (Geog. and Geol.) one project summarizing IGY findings on Antarctic circulation.

Michigan State - one project called the tundra problem.

b. The sources of the funds vary: Washington receives support from ONR, GRD, IGY and IGC; Wisconsin from ONR; Michigan from SIPRE and NSF; New York Univ. from GRD; Georgia (no source given); Michigan State Univ. from MSU.

c. Logistics has been done by the Air Force mainly with charter plane to the Blue Glacier, Wisconsin by their own plane and some by SIPRE. Present logistics for work at P. Barrow by ONR.

2. Projects completed within the last 5 years

Washington - An extensive study of Arctic meteorology directed by Richard J. Reed which has resulted in no less than 5 finished theses, 6 or 7 reports and 5 papers presented at scientific meetings. Others include heat budget work at both the Lemon Creek and Blue Glaciers by Richard Hubley; some reports on the Blue Glacier by Ed LaChapelle and on Station Alpha by Untersteiner and Badgley. Some of the theses published papers and a few selected reports are appended. In all, 7 theses, 8 published papers and numerous reports (to those furnishing funds) including seven scientific reports have been produced thus far.

Michigan - One project, on a Weather Bureau contract, on certain features of a total hemispherical radiometer (for Antarctic application).

3. Three schools plan future projects.

Washington - Hopes to continue pack-ice studies in the Arctic on heat budget, sea-ice drift, petrofabrics, albedo, fog and low stratus penetration of energy in snow perhaps some geological implications of ice warping and thrusting, and perhaps a little in earth currents. The higher altitude work will consist of continued work on the Blue Glacier and the photographic work of glaciers in the Northern Cascades to determine growth and/or shrinkage. Also planned is a photographic survey of some Southeast Alaska glaciers.

Wisconsin - Will continue their work on heat budget of lakes

Michigan - Plans to propose three projects; one on winter-summer reversal of polar stratospheric circulation, another on development of meteorological instruments for polar research and a third on radar analysis of precipitation processes in polar regions.

Michigan State University (Geog) - Reports one faculty man is interested in aspects of the physical environment especially in Alaska.

4. Deficiencies

Michigan stated they felt that lack of funds was a deficiency.

Wisconsin stated that the cost of field work in both money and time was so great that it left little money and time for analysis of data or to pursue related laboratory activities. Further, Wisconsin felt the lack of compact, reliable recording weather stations for remote areas and the need for longer range instrumented aircraft than the Cessna 195. They would also like a light-weight sonic ice thickness meter.

Washington feels there are a number of deficiencies, primarily that the military (Air Force) has demanded that it do the logistics for Stations Alpha and Charlie and this has left much to be desired. Flying was done when and if there was time and suitable aircraft available and the cost appeared unreasonably high. Because the military performed the logistics they were then in the "drivers seat" and hence told the scientists when the stations were being evacuated. Scientific work was then essentially at the will and mercy of the military; it will always be dependent on logistics. Further, there is a distinct lack of qualified trained personnel further aggravated by the lack of desire of many qualified people to want to do work under the rigorous Arctic environment. This deficiency can be solved only by universities training more people for polar work. Still another grave drawback is the lack of instruments which will operate with a minimum of maintenance and repair in polar cold; sensing elements in the air become fouled quickly in the Arctic. True, it is that the cost per observation is very high and always will be but that should not deter the U.S. from making far more complete coverage of the Arctic than it has half-heartedly done during and after IGY. It was impossible to get a light aircraft at either station to do satellite station (to Alpha and Charlie) work and albedo, etc. between. Continuity of guaranteed funds is still more critical for polar work than for other research because trained personnel are really not interested in short period, keep-you-on-if-the-contract-is-renewed basis.

Part V - Summary

The survey shows only three schools - Michigan, Washington and Wisconsin are seriously engaged in meteorology of the polar regions. Each one appears to be making an attempt to do more research and would like to expand their research. Other schools indicate they have done some work and continuing to do some work of such a nature that there are polar applications. At all schools the research is not on a firm,continuing basis because of several deficiencies, most of which were listed in Part IV, Paragraph 4. These deficiencies may be listed again.

1. Funds: All schools feel the lack of sufficient funds to purchase equipment, pay salaries for highly trained men, provide such logistics as can be controlled by the schools and provide for thoughtful, penetrating analysis of data without a hurried deadline.

2. Continuity of Support: The year by year support of contract research has so many deficiencies which have been listed in innumerable reports that no further comment is needed.

3. Personnel: Because of the arduous nature gathering data in an unfriendly environment by small groups of people isolated from the rest of the world the number of available trained people already too small is further greatly reduced. This necessitates obtaining as many highly trained people as are willing to undertake polar work and training them for the particular type of work involved. This leaves much to be desired because all too often those who can be enticed to go to polar regions are of a graduate student type who looks upon a period of work in polar regions as a means of obtaining a grub-stake to continue his education. Fortunately there are a few men who have obtained their doctorate who are willing to live in polar regions for as long as four to six months.

Because of the confined isolation it would be preferable to screen the personnel for psychological defects before sending them to their fieldwork in order that cabin-fever does not develop.

4. Logistics: Much of the success of polar work depends upon logistics. If logistics is performed by an unenlightened military branch which performs its work secondarily to other duties the scientific work will suffer in more ways than one. The writer feels that he is being perfectly fair in stating that the Air Force did not do a good job on the logistics of Stations Alpha and Charlie. On the other hand thus far the Navy appears to be far more friendly toward scientific work. Much of the success of any work in polar regions is dependent upon the attitude of who ever does the logistics.

5. Instruments: There needs to be a great deal of work done to develop instruments which will operate automatically with a minimum of maintenance and repair for both attended and non-attended equipment for the polar regions. Frequently aerial sensing elements become fouled from rime and frost. Thus far there has been no work done to determine whether or not sensing elements can be so designed and mounted to prevent such failure.

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Appendix

University of Washington papers, etc. on Arctic

Theses

Cushman, C.S., Interdiurual Temperature Variations in Alaska; 1953

Tank, W.R., Case Study of a High-Latitude Cold-Core Cyclone; 1955

Hubley, R.C., Analysis of Surface Energy Exchange During Ablation Season on Lemon Creek Glacier, Alaska; 1956

Campbell, W.J., Study of the Arctic Jet Stream; 1958

Baughman, R.G., Field Measurements of Drifting Snow; 1958

Kunkel, B.A., Synoptic-Climatological Study of the Arctic Circulation in Summer; 1959

Wilson, R.K., Attempt to Measure Water Vapor Divergence over Greenland by Radiosonde Data; 1959

Dickey, W., Local Winds in the Arctic

Williams, N., Method of Wind Analysis in Mountainous Regions

Lord, R., In progress

Papers

Cushman, C.S., Recent Temperature and Precipitation Trends in Alaska; 1953

Hubley, R.C., Problem of Short Period Measurements of Snow Ablation; 1954

Hubley, R.C., Measurements of Diurnal Variations in Snow Albedo on Lemon Creek Glacier, Alaska; 1955

Hubley, R.C., Analysis of Surface Energy Exchange During Ablation Season on Lemon Creek Glacier, Alaska; 1957

Reed, R.J., Arctic Weather Analysis; 1958

LaChapelle, Ed., Errors in Ablation Measurements from Settlement and Sub-Surface Melting; 1959

LaChapelle, Ed., Annual Mass and Energy Exchange of Blue Glacier; 1959

Untersteiner, N. and Badgley, F., Preliminary Results of Thermal Heat Budget Studies on Arctic Pack-Ice During Summer and Autumn; 1959

Schwarzacher, W., Pack-Ice Studies in the Arctic Ocean; 1959

Two papers accepted for publication

Scientific Reports

Miscellaneous Studies of Polar Vortices
Arctic Weather Studies - Summer Season
Synoptic Studies in Arctic Meteorology
Arctic Weather Analysis and Forecasting
Dynamical Predictions for the Arctic: Summer Season
Arctic Circulation Studies

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